Madroño, Vol. 47, No. 4, pp. 253–258, 2000

FLORISTIC STUDIES IN CONTEMPORARY BOTANY

Theodore M. Barkley
Botanical Research Institute of Texas, 509 Pecan Street,
Fort Worth, TX 76102-4060

Abstract

This paper outlines the traditional procedures for monographic and floristic studies, and points out that floristic studies are a link between the producers and the consumers of botanical information.

This paper is derived from a talk titled "Systematics, Informatics, and Floristics" that was presented at the Jepson 50th Anniversary Celebration and Scientific Symposium in June, 2000, at the University of California, Berkeley. The purpose of this paper is to review how botanical information flows from creators to consumers, and the central role of floristics in that process.

Mankind's age-long study of plants has produced an amazing legacy, which is evident in any scholarly library (Barkley 1993). Systematists who add to the accumulating knowledge believe that it all has meaning, and presumably it is useful to people outside of the bounds of botany. The diagrams presented here show how the information of systematic botany is accumulated and how it reaches the consumer in useful form.

Monographs and revisions (i.e., "monography") are the "soul of systematics," as pointed out so neatly by Stuessy (1975). Those studies are taken to be the fundamental syntheses of systematic knowledge and are the roadmaps for subsequent studies. The term "monograph" has been used for the larger and more sumptuous studies, while "revision" has meant studies presented in less detail. The central goals of both are similar, however, and, as with many species, there is no sharp distinction between the two. In this paper, all such studies are called "monographs." Traditional monographs focus on some natural group, such as a genus or a section of a genus, and they include, among other things, delimitations and descriptions of the entities, keys, hard data on ranges and habitats, and an ordered nomenclature. Modern monographs are also expected to include information on the biology of the group and on natural relationships. A how-to outline for a monographic study was presented by A. S. Hitchcock, the noted agrostologist, in a remarkable book called *Descriptive Systematic Botany* (Hitchcock 1925). The book is the product of an earlier era, and even though the author had few of the techniques that are available to us now, it is still well worth revisiting, for the author laid out a clear recipe for the standard procedures of monography. Arguably, contemporary monography rests upon the procedures outlined by Hitchcock, to which have been added many new sources of information and schemes for interpretation.

Two matters were particularly important in the first half of the 20th century for the development of monography. The first was the intentional incorporation of evolutionary questions. Beginning about 1930, a monograph was regarded as incomplete if it did not offer some understanding of evolutionary relationships among the entities under consideration. One of the first and clearest monographs to be published in the USA that had evolutionary relationships as a chief goal was the treatment of the genus *Haplopappus* by H. M. Hall (1928). Therein the author tried mightily to develop phylogenies as he understood them. It is not important that Hall's techniques are now seen as inadequate and that many of the monograph's conclusions are no longer tenable; what is important is that he acted upon the assumption that good monography must be centered upon evolutionary relationships.

The second matter was the advent of new laboratory techniques, which boosted systematic studies into an experimental science with garden and greenhouse studies, cytogenetics, comparative cytology, the analysis of secondary metabolites, etc. These studies came to be called "biosystematics" and have produced imaginative and detailed monographic treatments. Biosystematics coupled comfortably with ecological studies such as pollination, seed dispersal, population biology, and geohistory, thereby further enriching the content of monography.

A new vista in monography was introduced with the arrival of cladistic theory and new information from molecular studies. Cladistic theory supplied a workable tool for showing evolutionary relationships, resulting in phylogenetic trees that could be objectively tested. Molecular studies have proved to be particularly compatible to cladistic analyses, and the two have created a vital subset of systematic studies that focuses on evolutionary relationships, rather than on species delimitation. There is a rich literature on cladistic theory and derived phylogenies. The application of the phylogenetic approach based upon cladistics is comfortably treated

in the recent textbook *Plant Systematics: A Phylogenetic Approach* by Judd et al. (1999).

Contemporary phylogenetic studies have recognized that the traditional Linnaean concept of species is imprecise at best and may be no longer justifiable (i.e., species are indeed specious). From the early 1990's to the present there has been a shower of literature on the creation of a new taxonomic scheme to reflect phylogenetic relationships, and indeed there was a symposium on the topic at the XVI International Botanical Congress in St. Louis, MO in 1999 (cf. Cantino 2000, and Cantino et al. 1999, for an introduction into the literature). It is doubtless true that changes are coming in how we conceive of "species," but the proposed phylogenetic classifications are yet to be elaborated, and are yet to be taken into the thinking of the consumers of botanical information. For the present, a conservative approach is prudent, and so the treatment of floristic botany rests upon the standard, albeit flawed, Linnaean notions of species.

Floristic studies account for all of the plants that occur in a particular region. Usually this is taken to mean the vascular plants, although the currently active Flora of North America project also includes the bryophytes. Hitchcock (1925) also includes a discussion on the methods of floristics, but without the notion of floras as encompassing summaries. The products of floristic studies are floras or manuals. The two are similar and intergradant, but as with monographs and revisions, the former are more sumptuous, often in several volumes, while the latter are stripped-down for convenient use. Floristic botanists derive their information from monographs and revisions, but when no monographic studies have been done, they must prepare nonce-treatments with the information at hand. If a floristic program required that all groups be treated at equal levels of sophistication, the flora would never be written.

Floristics are best done by botanists with field-familiarity in their region who also have good herbarium and library resources. The techniques for synthesis have been largely intuitive, based upon the botanist's memory and ability to organize great amounts of detail. But, just as cladistics and molecular data added a huge new approach to monography, electronic information management ("informatics") is changing floristics. It is now thinkable that a floristic project can account for vast amounts of information that effectively lie fallow, and that, through floristic programs and their computer links, this buried information can be brought to the surface. To be certain, floristic projects that are based on informatic techniques are in their infancy, but the future impact is already evident. Three notable computer-based programs come to mind (but there are others, not mentioned here): (1) The magnificent summary of information on the North American Flora as compiled by John Kartesz in his Biota of North America Program (BONAP) and distributed on a CD-ROM that was prepared by Kartesz and Meacham (1999). (2) The detailed Flora of Florida project centered at the University of South Florida and prepared by Richard P. Wunderlin and assisted by Bruce F. Hansen (a manual was published in 1998). (3) The theoretical works of Hugh Wilson at Texas A&M University. The application of informatics technologies to floristic projects is not easy. The Flora of North America made an effort to incorporate informatics theory, which proved to be administratively difficult.

Explanations of the Figures

Figure 1 simply notes the cascade of information from monographs and revisions through the floras and on to the consumers. The consumers are a mixed lot; here they are called "primary," "indirect," and "ultimate." The primary consumers are scientific and academic professionals whose expertise is not in systematic botany but whose experience gives them the ability to judge the accuracy of the information. These are the botanists' colleagues. The indirect consumers are a large group who use what is in floristic treatments essentially on faith. It is this group for whom the accumulated wisdom in the herbaria and libraries is likely to be of greatest interest and least accessible. Floristic projects have an awesome opportunity to connect this group with botanical information. The ultimate consumer is simply the person who needs information about a plant, e.g., the person who asks, "Is this crabgrass in my lawn? What do I do about it?" In many states, the Cooperative Extension Services are geared to accumulating information from primary consumers and delivering it to the ultimate consumer.

Figure 2 summarizes the preparation of a monograph, starting with the definition of the problem and the early survey work. Items 3 and 4 are critical, for here the monographer's experience (or if a graduate student, the experience of the student's mentor) calls for the building of hypotheses and expressing them as testable models. Items 5–8 are the chief sources of information useful in monography; they are not mutually exclusive, and some techniques have elements of two or more of these items. Clearly, comparative morphology is of great importance because it is easily accessed in the herbarium, there is a lot of it, and the techniques for using morphological information are of long tradition. Items 6 and 8 include such matters as pollination studies, populational studies, introgression, the role of climate change, etc. The last item has become increasingly significant with the advent of readily accessible Geographic Information Systems (GIS). Item 9 is legalistic, mechanical, and utterly essential, for it is how the entities are given their correct names. Information from items 5–8 are assimilated and the results are compared to the hypotheses and models generated in items 3 and 4.

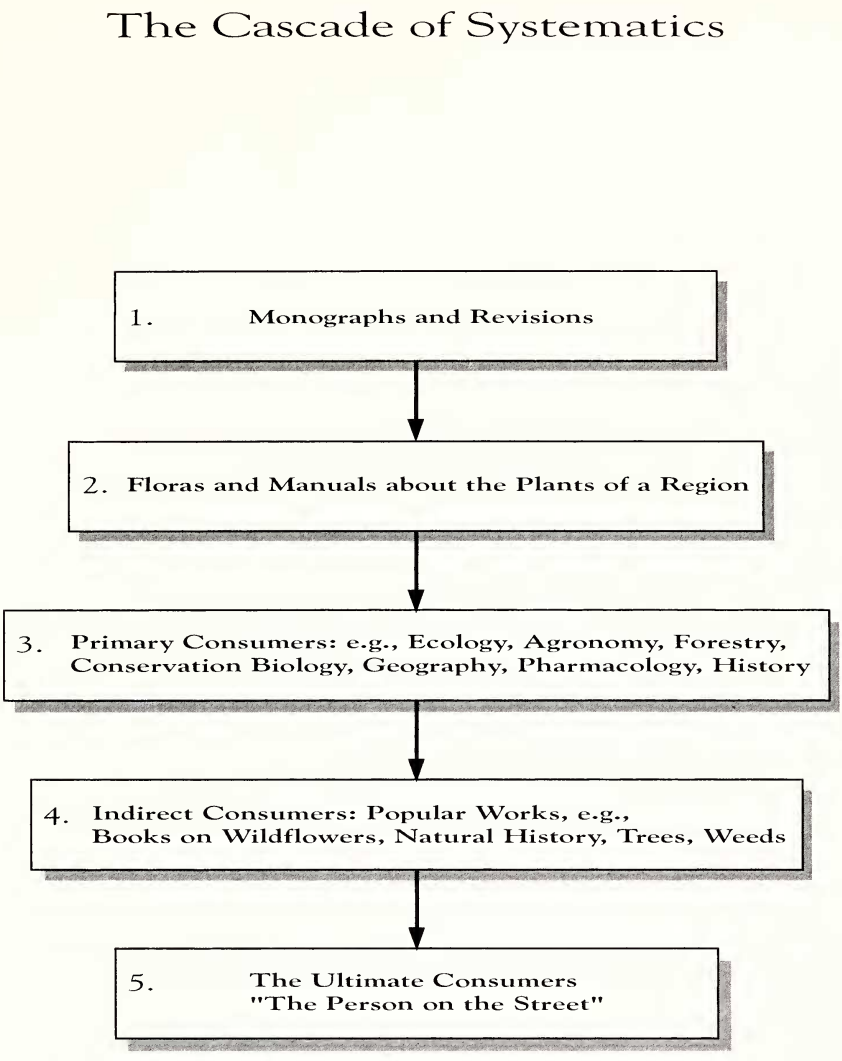

FIG. 1. Explanation in text.

During the assimilation stage, phylogenetic (cladistic) techniques are applied, which yield justified evolutionary trees showing the current understanding of natural relationships. It is noteworthy that many phylogenetic studies that are based on molecular data focus on higher groups, such as genera or families, and that species-centered phylogenetic studies often rest upon large components of morphological data. Item 12, integration, is the aligning of the information into the customary format for monographic studies. Keys, descriptions, specimen citations, sources of data, and conclusions drawn are presented in traditional ways, making the monograph (item 13) a readily understandable and useable document, whether published as hard copy or on a website.

Figure 3 notes the assimilation of information from monographs and other sources into a floristic treatment. Items 1 and 2 are obvious; the parameters of the project must be understood to account for the biological complexities of the region and the expectations of the intended users of the flora. Primary information is taken from monographs and revisions as much as possible, but when no monographic works are at hand, it is necessary to create treatments as best as possible; this step essentially incorporates items 3, 4, and 9 of Figure 2. Item 4, preparation of the treatments, is demanding and most easily accomplished by botanists with at least some monographic experience. Computer-assisted techniques are potentially very useful in item 4 (e.g., DELTA) but to date these techniques have long and steep learning curves. Many floristic botanists are not ready to embrace the computer as a tool to prepare keys, descriptions, and other textual matters. However, computer-based programs for generating maps are clearly with us. Text matters generated in item 4 can be entered into a website

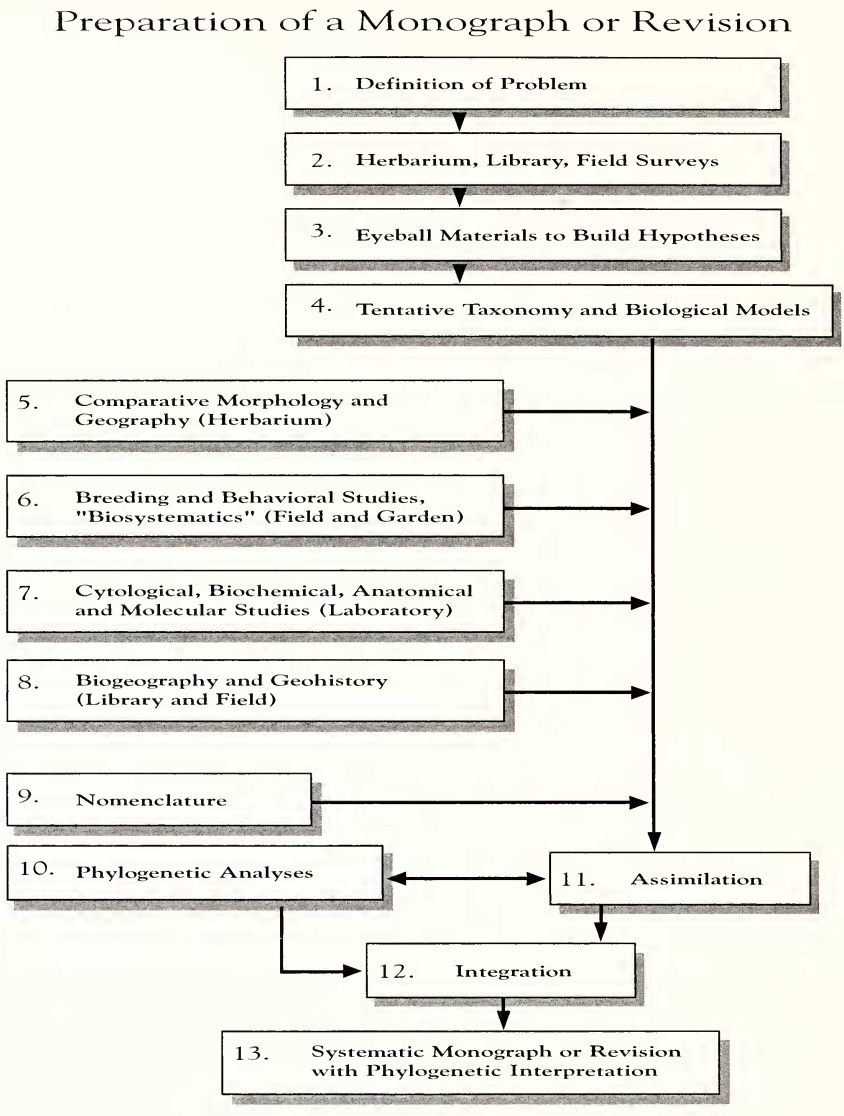

FIG. 2. Explanation in text.

to facilitate the following steps and the production of the final flora. Item 6 is also particularly demanding, for here is where the tentative product is critically tested and edited for accuracy. Taxonomic reviews treat the botanical matters; regional reviews account for distributions and regional variation. Item 7, amplifications, is the addition of information needed by the intended users of the flora, i.e., the consumers. Item 8 is where the manuscript is treated for editorial consistency, where the general keys are created and tested, and where the introductory essays are prepared and incorporated. The product may be published as hard copy (item 10) or posted on a website (item 11). A flora that is conveniently available on a website is easy for a primary consumer to consult when addressing broad questions (item 12), e.g., questions that were not in the minds of the botanists who did the various studies that led to monographs or floras. A flora has a wealth of information relevant to distributions, variations, phenologies, etc., that may be coupled with soil types, geohistorical matters, archaeology, medicine, and other areas not yet conceived. The point is that the hard data of the core of systematic botany are translated for use by others through floras.

CONCLUSIONS

The abiding points are simple: There is a huge body of literature in libraries and specimens in herbaria that are the products of botanical enterprise. Monographic studies are done to determine what entities exist, how to distinguish among them, how

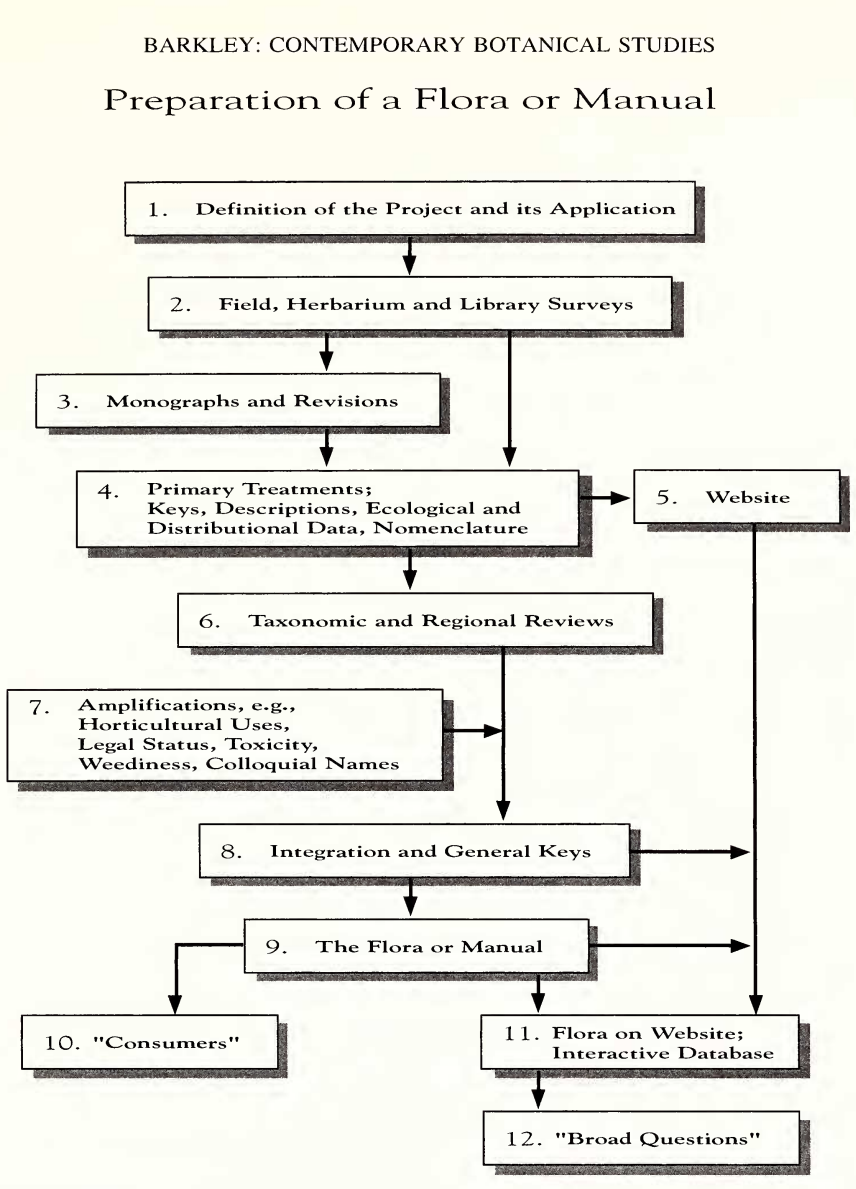

FIG. 3. Explanation in text.

they are related to each other, and how they behave. Monographic studies have spawned very interesting derivatives that relate to sophisticated understandings of evolution, but that still fall within the shadow of monographic studies. Floristic studies filter and assimilate the accumulated wisdom of the plants of a region and couple it to those who use the information. It is not for nothing that we recall a botanical beatitude attributed to the late Lloyd H. Shinners: "Blessed be those who write floras, for they shall discharge the botanists' responsibilities to the public."

Note: A review of the growth of taxonomic concepts over the past half-century was recently published by P. F. Stevens in a series of "Jubilee Papers" in the journal Taxon (Stevens 2000). It appeared too late to impact the presentation of this paper at the Jepson Symposium in June, 2000.

LITERATURE CITED

BARKLEY, T. M. 1993. Synthesis: a historical perspective. Annals of the Missouri Botanical Garden 80:292–296.

CANTINO, P. D. 2000. Phylogenetic nomenclature: addressing some concerns. Taxon 49:85–93.

———, R. G. OLMSTEAD, AND S. J. WAGSTAFF. 1997. A comparison of phylogenetic nomenclature with current systems: a botanical case study. Systematic Biology 46:313–331.

HALL, H. M. 1928. The genus *Haplopappus*: a phylogenetic study in the Compositae. Publ. Carnegie Institution (Washington) 389:i–viii, 1–391.

HITCHCOCK, A. S. 1925. Methods of descriptive systematic botany. John Wiley & Sons, New York.

JUDD, W. S., C. S. CAMPBELL, E. A. KELLOGG, AND P. F. STEVENS. 1999. Plant systematics: a phylogenetic approach. Sinauer Associates, Sunderland, MA.

KARTESZ, J. T. AND C. A. MEACHAM. 1999. Synthesis of

the North American Flora. CD-ROM. North Carolina Botanical Garden, Chapel Hill, NC.

STEVENS, P. F. 2000. Botanical systematics 1950–2000; change, progress, or both? Taxon 49:635–659.

STUESSY, T. F. 1975. The importance of revisionary studies in plant systematics. Sida 6:104–113.

WUNDERLIN, R. P. 1998. Guide to the vascular plants of Florida. University of Florida Press, Gainesville, FL.